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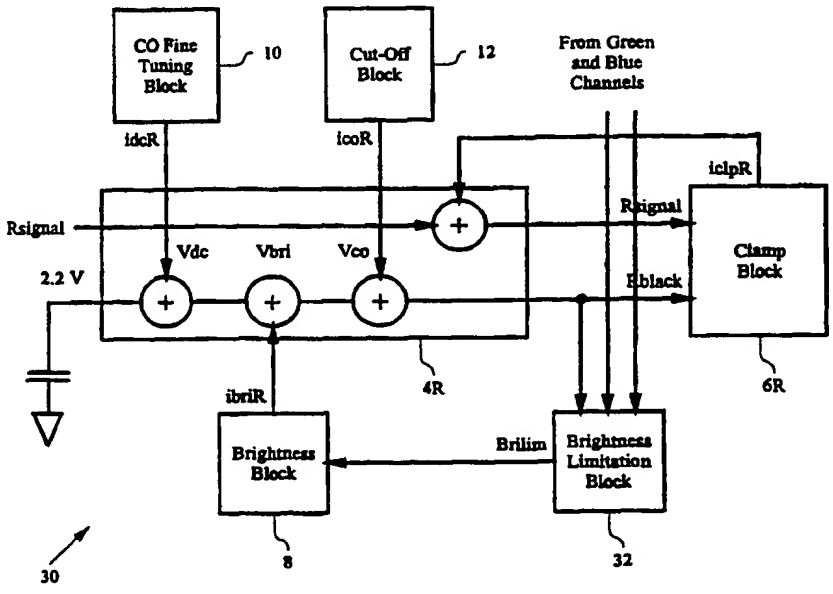

(57) Abstract

Television circuits which operate at low voltages can have difficulties with signal clipping effects. Accordingly, a brightness limitation system is employed in such a television circuit to prevent the black reference voltage level and the video signal from entering a minimum signal clipping zone, to provide a precise correction signal, limiting the brightness, to maintain a constant black reference voltage level, and maintain a video signal with dynamic amplitude. The brightness limitation circuit detects a minimum signal level amongst the black reference signals from each colour channel and compares the minimum signal with a fixed voltage level to generate a brightness feedback signal. The brightness feedback signal is then used to modify the black reference signal level for each colour channel.

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AUTOMATIC BRIGHTNESS LIMITATION FOR AVOIDING VIDEO SIGNAL CLIPPING

Field of the Invention

This invention relates to a method and apparatus for avoiding signal clipping in a video signal by automatically controlling brightness limitations.

Background Art

Television circuits are commonly designed or modified so as to further integrate the functions thereof to enable operate with low power consumption. However, discrepancies can arise when the power supply is reduced. For example, a clipping effect may occur when the signals reach a minimum or maximum voltage level. The signal may deteriorate in shape in these circumstances.

As far as waveform is concerned, the television circuit required to maintain a signal with desired dynamic amplitude, even if the power supply is reduced. Therefore, preventive measures may be required with the implementation of a brightness limitation block to avoid the black reference voltage level and the video signals from reaching undesirable levels. Furthermore, the black reference voltage level should be controlled in a constant manner.

Summary of the Invention

In accordance with the present invention, there is provided a video signal processing system comprising, for each colour channel, a control circuit and clamping circuit for generating a colour channel reference signal and controlling a colour channel video signal, and a brightness limitation circuit coupled to receive the colour channel reference signal from each of the colour channels and coupled to provide a feedback signal to regulate a brightness level of each video signal according to a comparison of a minimum signal level amongst the colour channel reference signals and a fixed reference signal level.

Preferably the brightness limitation circuit comprises a minimum detection circuit for detecting and outputting a minimum signal level from amongst the colour channel reference signals, and a comparator having as inputs the fixed reference signal level and the minimum signal level, so as to produce the feedback signal as output. In a particular embodiment of the invention, the comparator is coupled to receive the minimum signal level at its negative input and the fixed reference signal level at its positive input.

Preferably each control circuit includes a plurality of adders coupled in the signal path of the corresponding colour channel reference signal, wherein the feedback signal is coupled as input to one of the adders. The feedback signal may be coupled from the brightness limitation circuit to the control circuit by way of a brightness control circuit which enables manual brightness adjustment of the colour channels.

In one form of the invention each control circuit includes an adder circuit coupled in the signal path of the corresponding colour channel video signal, wherein a feedback signal from the clamping circuit, generated according to the colour channel video signal and the colour channel reference signal, is coupled as input to the adder circuit.

The present invention also provides a video signal processing circuit for regulating colour channel video information signals, comprising a minimum signal detector for detecting a minimum signal level amongst a plurality of colour channel reference signals, a comparator which compares the minimum signal level with a fixed voltage reference signal and generates a corresponding output, and an additive feedback coupling of the comparator output signal and each of the colour channel reference signals.

The present invention further provides a video signal brightness controller, comprising:

a plurality of colour channel control means each coupled to receive as input a respective colour channel video signal and colour channel reference signal and generate a respective adjusted colour channel video signal and adjusted colour channel reference signal;

a plurality of clamping means, each clamping means corresponding to a respective colour channel control means and being coupled to receive as input the respective adjusted colour channel video signal and adjusted colour channel reference signal and produce a corresponding clamping feedback signal; and

a brightness limitation means coupled to receive the adjusted colour channel reference signal from each colour channel control means and produce a corresponding brightness feedback signal;

wherein each of the colour channel control means includes a first adder in path of the colour channel video signal, to which the clamping feedback signal is coupled, and a second adder in the path of the colour channel reference signal, to which the brightness feedback signal is coupled.

Brief Description of the Drawings

The invention is described in greater detail hereinafter, by way of example only, with reference to a preferred embodiment thereof and the accompanying drawings, wherein:

Figure 1 is a functional block diagram illustrating a known television signal control system;

Figure 2 is an illustration of a brightness curve;

Figures 3 and 4 illustrate of video signals from a known system;

Figure 5 is a circuit diagram of an output portion of a control block;

Figure 6 is a functional block diagram of a television signal control system incorporating a brightness limitation block according to an embodiment of the present invention;

Figure 7 is a block diagram of a brightness limitation circuit;

Figure 8 is a simplified functional block diagram of a video signal control system according to an embodiment of the present invention; and

Figure 9 shows several voltage range diagrams illustrating the operation of an embodiment of the invention.

Detailed Description of the Preferred Embodiments

Figure 1 shows a fundamental functional block diagram of an existing system 2 for controlling the signals of red, green and blue channels before these signals are distributed to the display tube of a television. Basically, this system includes, for each of the red, green and blue channels, a control block (4^R,4^G, 4^B)and a clamp block (6^R, 6^G, 6^B) , a brightness block 8, a cut-off (CO) fine tuning (DC) block 10 and a cut-off (CO) block 12. Since the control and clamp blocks are identical for each channel, only the red channel is discussed hereinbelow in the interests of clarity.

The control block 4 is mainly constructed using adders to control the video signals to present perfect pictures for display on the television screen. The appropriate CO brightness DC and clamping input signals are mixed together to generate accurate output signals, Rsignal, Gsignal, Bsignal, Rblack, Gblack and Bblack. The generated output Rsignal is an output signal that contains video information, while Rblack is an output signal that provides a black reference voltage level. The control block, however, is sensitive to the signals with low voltage, as discussed in greater detail hereinbelow.

The clamp block 6 receives Rsignal and Rblack as input signals from the control block 4. The clamp block is used to clamp the Rsignal signal, which means that Rsignal is aligned with the Rblack signal, as illustrated in Figure 2, to maintain a stable black level or picture brightness. The output signal from the clamp block 6, iclpR is fed back to the control block 4 to determine the amplitude difference between the Rsignal and Rblack signals for performing further alignment if necessary.

The brightness block 8 is used to adjust the black reference voltage level Rblack. Brightness can be adjusted by the user with the use of remote control or from the television set itself. The CO fine tuning (DC) block 10 is used to fine tune the black reference voltage level which is controlled by the internal circuit as described below. The signals for brightness adjustment consists of ibriR, ibriG and ibriB, and the signals for DC adjustment comprise idcR, idcG and idcB, and are passed to the respective control blocks (Figure 1).

The cut off block 12 is used to control the red, green and blue electron guns so as to provide an accurate black reference voltage level. This is required because signals for the electron guns have a high spread. Manual cut off adjustment is usually performed at the manufacturing stage. Tuning has to be done if the quality of one colour is different from a defined colour. This adjustment is made with the use of a potentiometer or by bus control whereby information is stored in a memory circuit of the television. On the other hand, automatic cut off adjustment can be done with a feedback loop configuration. Both methods allow correction signals of icoR, icoG and icoB to be varied from Vco(min) to Vco(max) as shown in Figure 2.

With reference to Figure 2, Rblack is an output signal that provides a black reference voltage level which is used for clamping purpose so that a constant black level can be maintained. Rsignal is an output signal which contains the red channel video information. A maximum signal clipping zone and minimum signal clipping zone are indicated in the figure and are referred to as forbidden zones, whereby both Rsignal and Rblack signals are prohibited from falling into these zones. However, the Rsignal signal can be fine tuned and adjusted with three adjustments. Namely, cut-off (CO) adjustment, brightness adjustment and CO fine tuning (DC) adjustment. Taking Vrblck as the black reference voltage level, the Rblack signal is able to swing from Vco(min) to Vco(max) when CO adjustment is being tuned. Similarly the Rblack signal is able to swing from Vbri(min) to Vbri(max) when brightness adjustment is being tuned. Likewise, the Rblack signal is able swing from Vdc(min) to Vdc(max) when DC adjustment is being tuned. During initialization, at time tl, when the television set is turned on, the Rsignal signal has to be aligned along the Rblack signal progressively. Alternately, alignment has to be made when any of the three adjustments has been fine tuned or adjusted. As a result, the signal of Rsignal also has a constant black level as it is in line with the Rblack signal.

Total adjustment is the addition of CO adjustment, brightness adjustment and DC adjustment. An equation of for the overall adjustment Vtotal is as shown below:

Total adjustment = CO adjustment + brightness adjustment + DC adjustment (Equ. 1)

$$Vtotal = Vco + Vbri + Vdc \quad \text{(Equ. 2)}$$

Figure 3 illustrates a video signal obtained from an existing system that operates with a 9 Volt power supply. Various voltages for the system as shown in Table 1, below, are based on assumption only.

Table 1

Names of Waveform	Voltage (Volt)
Black to White (B/W) Pulse	3 Vp-p
Vrblck (typical)	3 volts
Vco (Maximum/Minimum)	+/- 1 Volt
Vbri (Maximum/Minimum)	+/- 0.9 Volt
Vdc (Maximum/Minimum)	+/- 0.15 Volt

To compute the voltages of Vtotal(max) and Vtotal(min)

Vtotal = Vco + Vbri + Vdc from (Equ. 2)

Vtotal(max) = (1 + 0.9 + 0.15) Volts

= +2.05 Volts

Vtotal = Vco + Vbri + Vdc from (Equ. 2)

Vtotal(min) = (-1 -0.9 -0.15)Volts

= -2.05 Volts

Typically, Rblack signal is set at the black reference voltage level (Vrblck) which is 3 Volts. Based on the calculation as shown above, this signal is allowed to swing positive by 2.05 Volts and negative by 2.05 Volts. In other words, it is able to vary from 0.95 Volt to 5.05 Volts. A further 3 Volts is required by the black to white (B/W) pulse with the contrast level set to maximum. Hence, the maximum level of the video signal is 8.05 Volts. A voltage margin of 0.95 Volts is reserved for sharpness adjustment and over modulation to occur. As such neither of the Rsignal and Rblack signals falls into the maximum and minimum signal limitation zones.

Thus, no problem is encountered with typical video amplitude.

Figure 4 illustrates a video signal obtained from an existing system that operates with an 8 Volt power supply. The objective of power supply reduction is to achieve a system that is able to function with low power consumption. At the same time, it must be able to maintain a video signal with reasonable dynamic amplitude. However, difficulties have been encountered in these circumstances.

The black reference voltage level (Vrblck) is compensated to 2.2 Volts as the power supply is reduced by 1 Volt. Similarly, Vrblck is allowed to swing positive by 2.05 Volts and negative by 2.05 Volts. Likewise, 3 Volts is required by the black to white pulse with the contrast level set to maximum. Hence, the maximum level of the video signal is 7.25 Volts.

To compute the range of Vrblck level, consider the following:

Let Vrblck be the final result of the black reference voltage level, and
Vrblck(current) be the present black reference voltage level.

$$Vrblck = Vrblck(current) + Vtotal \qquad \text{(Equ. 3)}$$

Therefore, $Vrblck(maximum) = (2.2 + 2.05)$ Volts

$= \underline{4.25 \text{ Volts}}$

and $Vrblck(minimum) = (2.2 - 2.05)$ Volt

$= \underline{0.15 \text{ Volt}}$

Based on the calculated results, the Rblack signal is only allowed to vary from 0.15 Volts to 4.25 Volts in this instance. A voltage margin of 0.75 Volt is reserved for further B/W pulse adjustment as mentioned before. This implies that the maximum signal clipping zone is not affected, however the minimum signal clipping zone is affected by the Rblack signal.

Figure 5 shows a circuit 20 of an output portion of a control block. Basically, it consists of an emitter follower Q1 coupled to a transistor Q2 which is biased at a fixed voltage, Vbias. Assume that, the Rblack signal (OUT) is allowed to fall to a voltage level of Vrblck(minimum) which is

as low as 0.5 Volt. Based on the calculation as shown above, it shows that Rblack signal (OUT) has reached to a voltage level of 0.15 Volt. This implies that the Rblack signal has already fallen into the minimum signal limitation zone. Hence, the voltage level (Vrblck) of Rblack signal is too low for Q2 to function properly. As such, it causes Q2 to operate in saturation.

In order to alleviate this problem, the television circuit can be equipped with a brightness limitation block, which can provide the following:

1. Prevention of the black reference voltage level (Rblack) and the video signal (Rsignal) from entering into the minimum signal clipping zone.
2. Provision of the brightness block with a precise correction signal, limiting the brightness.
3. Maintenance of a constant black reference voltage level at Vrblck minimum.
4. Maintenance of a video signal with dynamic amplitude.

In order to overcome the above mentioned difficulties, a brightness limitation block 32 can be implemented in the system 30 as shown in Figure 6. Signals of Rblack, Gblack, and Bblack from the respective control blocks 4^R, 4^G, 4^B are connected to the inputs of the brightness limitation block 32. The output of the brightness limitation block, Brilim is fed back to the brightness block 8. With this configuration, it contributes the difference between the existing system and the proposed system.

With reference to Figure 7, a simple exemplary implementation of the brightness limitation block 32 is shown, including a comparator 34. A minimum detector 36 is introduced before the input of the comparator, which can be easily done using diodes. The output of the minimum detector is applied to the negative input of the comparator while the positive input of the comparator is maintained with a fixed voltage, Vrblck (minimum) with respect to ground.

The function of the minimum detector 36 is to select only one of the three input signals with the lowest voltage. Subsequently, this signal is reflected on the output of the minimum detector.

A comparison is made between the voltage at the negative input and the positive input of the comparator 34. If the voltage at the negative input is less than Vrblck(minimum) at the positive

input of the comparator, a signal will be generated at the output, Brilim. The signal at Brilim will correspond to the amplitude between Vrblck(minimum) and the signal at the negative input of the comparator. This correction signal is fedback to the input of the brightness block 8. As such, the signal of Rblack is prohibited from entering the minimum signal clipping zone.

On the other hand, if the voltage at the negative input is greater than the Vrblck(minimum) at the positive input of the comparator, no signal is generated at the output, Brilim. Therefore, it is not necessary to add to the signal being passed to the brightness block as it did not enter beyond the minimum signal clipping zone.

Figure 8 shows a simplified block diagram of the circuit 30 shown in Figure 6 (for the red channel only), to further elaborate the detailed operation of the new system. Basically, the control block 4 comprises four adders: three adders are included along the Rblack signal path and one adder is included along the Rsignal path. The brightness block 8 is used to provide brightness adjustment, the CO fine tuning block 10 is used to provide DC adjustment, and the Cut-Off block 12 is used to provide CO adjustment.

As described above, if the Rblack signal from the control block 4 is less than Vrblck(minimum), a correction signal, Brilim, will be generated and fedback to the brightness block. In the brightness block the correction signal, Brilim, may be combined with a manual brightness adjustment signal, using an adder or the like, to form the ibriR signal provided to the control block. Subsequently, this signal is added to the Rblack signal so as to avoid it from falling into the minimum signal limitation zone.

Alignment is performed with the use of the clamp block 6. A comparison is made between the Rblack and Rsignal signals. An iclpR signal is then generated at the output of the clamp block which indicates the amplitude difference of both signals if they are different. Eventually, iclpR signal is added into the Rsignal signal. As such, the Rsignal signal is superimposed on the Rblack signal and alignment has been done.

Example calculations are set forth below to illustrate how the Rblack signal is prevented from

entering the minimum signal limitation zone with the implementation of the brightness limitation block as described above.

Example 1

Assume that Vrblck(current) = 2.2 volts,

Vco(minimum) = -1 Volt,

Vdc(minimum) = -0.15 Volt,

and the brightness limitation block is intended to prevent Vrblck from falling below 0.5 Volt. It is possible then to determine what is the Vbri(minimum) that is required to be added into the control block.

Vrblck = Vrblck(current) - Vco - Vdc - Vbri from (Equ. 3)

0.5 = 2.2 - 1 - 0.15 - Vbri

Thus, Vbri = -0.55 Volt , ideally Vbri(minimum) = -0.9 Volt

Therefore, Vbri from the brightness block would be greater than -0.55 Volt, otherwise, it will cause Vrblck to fall into the minimum signal limitation zone. This indicates that there is a significant increase of voltage, Vbri from -0.9 Volt to -0.55 volt, to provide the correction (refer Figure 9).

Example 2

Assume that Vrblck(current) = 2.2 Volts,

Vco = -0.8 Volt, and

Vdc (minimum) = -0.15 Volt.

It is possible then to determine the minimum Vbri.

Vrblck = Vrblck(current) - Vco - Vdc - Vbri from (Equ. 3)

0.5 = 2.2 - 0.8 0.15 - Vbri

Hence, Vbri = -0.75 Volt , ideally minimum Vbri = -0.9 Volt

Therefore, Vbri from the brightness block should not be greater than -0.75 Volt. This indicates that there is a significant increase of voltage Vbri, from -0.9 Volt to -0.75 Volt, to provide the correction (Refer figure 9).

Based on simulation results of this system, it has been shown that the black reference voltage level and the video signal are prevented from entering into the minimum signal clipping zone. Moreover, a constant black reference voltage level and the video signal with dynamic amplitude are maintained.

The foregoing detailed description of the preferred implementations of the present invention has been presented by way of example only, and is not intended to be considered limiting to the invention as defined in the appended claims.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

Claims

1. A video signal processing system comprising, for each colour channel, a control circuit and clamping circuit for generating a colour channel reference signal and controlling a colour channel video signal, and a brightness limitation circuit coupled to receive the colour channel reference signal from each of the colour channels and coupled to provide a feedback signal to regulate a brightness level of each video signal according to a comparison of a minimum signal level amongst the colour channel reference signals and a fixed reference signal level.

2. A video signal processing system as claimed in claim 1, wherein the brightness limitation circuit comprises a minimum detection circuit for detecting and outputting a minimum signal level from amongst the colour channel reference signals, and a comparator having as inputs said fixed reference signal level and said minimum signal level, and producing said feedback signal as output.

3. A video signal processing system as claimed in claim 2, wherein said comparator is coupled to receive said minimum signal level at its negative input and said fixed reference signal level at its positive input.

4. A video signal processing system as claimed in claim 2 or 3, wherein each said control circuit includes a plurality of adders coupled in the signal path of the corresponding colour channel reference signal, and wherein said feedback signal is coupled as input to one of said adders.

5. A video signal processing system as claimed in claim 4, wherein said feedback signal is coupled from the brightness limitation circuit to the control circuit by way of a brightness control circuit which enables manual brightness adjustment of the colour channels.

6. A video signal processing system as claimed in claim 5, wherein said brightness control circuit incorporates an adder for combining the feedback signal with a manual brightness adjustment signal.

7. A video signal processing system as claimed in claim 4, further including at least one cut-off adjustment circuit coupled to provide input to a respective adder in the signal path of the colour channel reference signal in each control circuit.

8. A video signal processing system as claimed in any one of claims 1 to 7, wherein each said control circuit includes an adder circuit coupled in the signal path of the corresponding colour channel video signal, and wherein a feedback signal from said clamping circuit, generated according to the colour channel video signal and the colour channel reference signal, is coupled as input to the adder circuit.

9. A video signal processing circuit for regulating colour channel video information signals, comprising a minimum signal detector for detecting a minimum signal level amongst a plurality of colour channel reference signals, a comparator which compares said minimum signal level with a fixed voltage reference signal and generates a corresponding output, and an additive feedback coupling of said comparator output signal and each of said colour channel reference signals.

10. A video signal processing circuit as claimed in claim 9, including a brightness control circuit for adjusting the video signal brightness level by manual adjustment of said colour channel reference signals, wherein said additive feedback coupling of said comparator output signal is coupled through said brightness control circuit.

11. A video signal brightness controller, comprising:

a plurality of colour channel control means each coupled to receive as input a respective colour channel video signal and colour channel reference signal and generate a respective adjusted colour channel video signal and adjusted colour channel reference signal;

a plurality of clamping means, each clamping means corresponding to a respective colour channel control means and being coupled to receive as input the respective adjusted colour channel video signal and adjusted colour channel reference signal and produce a corresponding clamping feedback signal; and

a brightness limitation means coupled to receive the adjusted colour channel reference signal from each colour channel control means and produce a corresponding brightness feedback signal;

wherein each said colour channel control means includes a first adder in path of the colour channel video signal, to which said clamping feedback signal is coupled, and a second adder in the path of the colour channel reference signal, to which said brightness feedback signal is coupled.

12. A video signal brightness controller as claimed in claim 11, wherein said brightness limitation means comprises a minimum signal level detector for detecting a minimum signal level amongst the plurality of adjusted colour channel reference signals, and a comparator for generating said brightness feedback signal on the basis of the detected minimum signal level and a fixed reference signal level.

AMENDED CLAIMS

[received by the International Bureau on 03 March 1999 (03.03.99); new claim 13 added; remaining claims unchanged (1 page)]

a plurality of clamping means, each clamping means corresponding to a respective colour channel control means and being coupled to receive as input the respective adjusted colour channel video signal and adjusted colour channel reference signal and produce a corresponding clamping feedback signal; and

a brightness limitation means coupled to receive the adjusted colour channel reference signal from each colour channel control means and produce a corresponding brightness feedback signal;

wherein each said colour channel control means includes a first adder in path of the colour channel video signal, to which said clamping feedback signal is coupled, and a second adder in the path of the colour channel reference signal, to which said brightness feedback signal is coupled.

12. A video signal brightness controller as claimed in claim 11, wherein said brightness limitation means comprises a minimum signal level detector for detecting a minimum signal level amongst the plurality of adjusted colour channel reference signals, and a comparator for generating said brightness feedback signal on the basis of the detected minimum signal level and a fixed reference signal level.

13. A method for regulating colour channel video information signals, comprising the steps of detecting a minimum signal level amongst a plurality of colour channel reference signals, comparing said minimum signal level with a fixed voltage reference signal and generating a corresponding comparator output, and providing an additive feedback coupling of said comparator output signal and each of said colour channel reference signals.

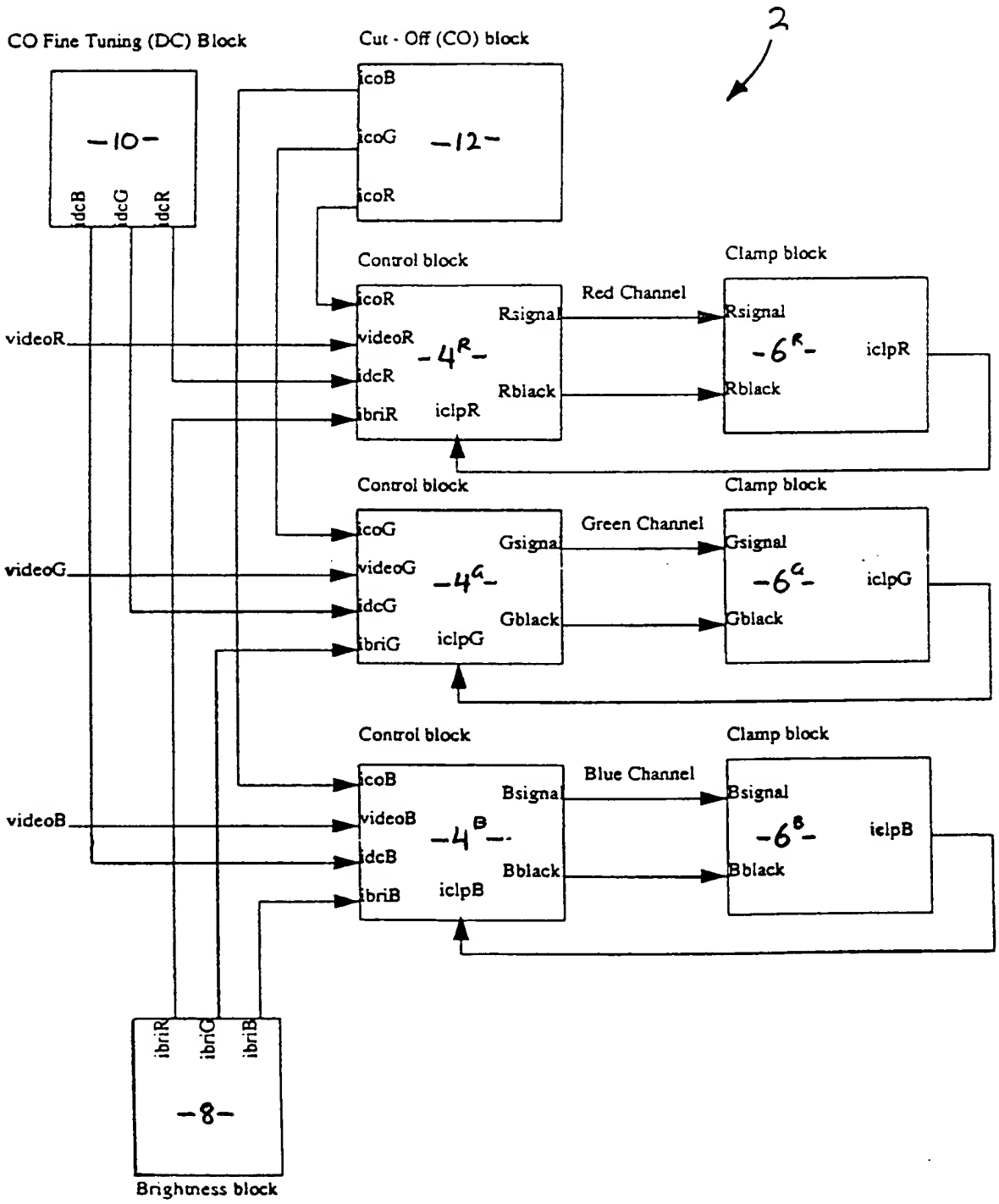
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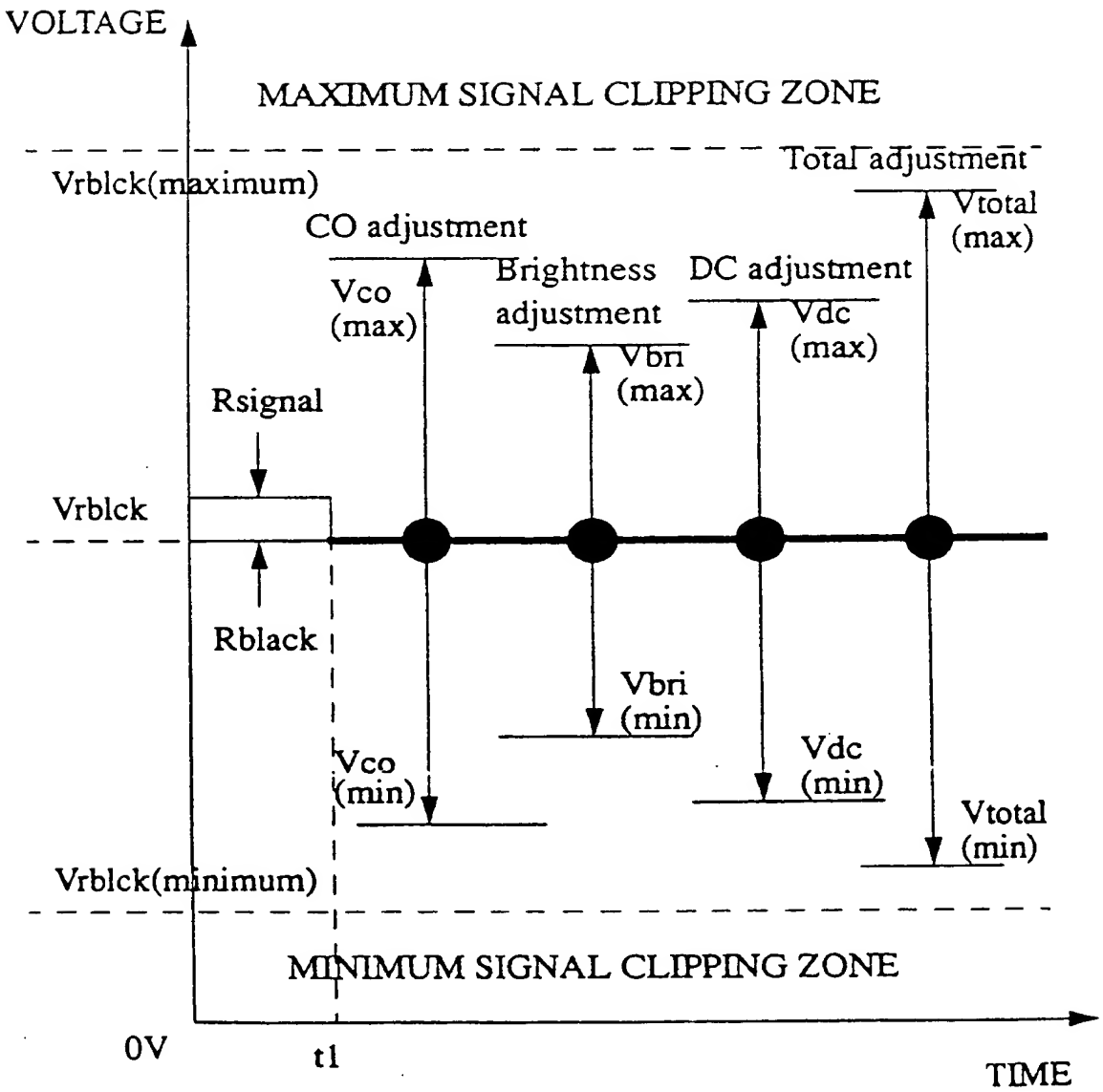
Figure 1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Vtotal (max)
CO adjustment
Vco (max)
Brightness adjustment
DC adjustment
Vdc (max)
Vbri (max)
Rsignal
Vrblck
Rblack
Vbri (min)
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0V
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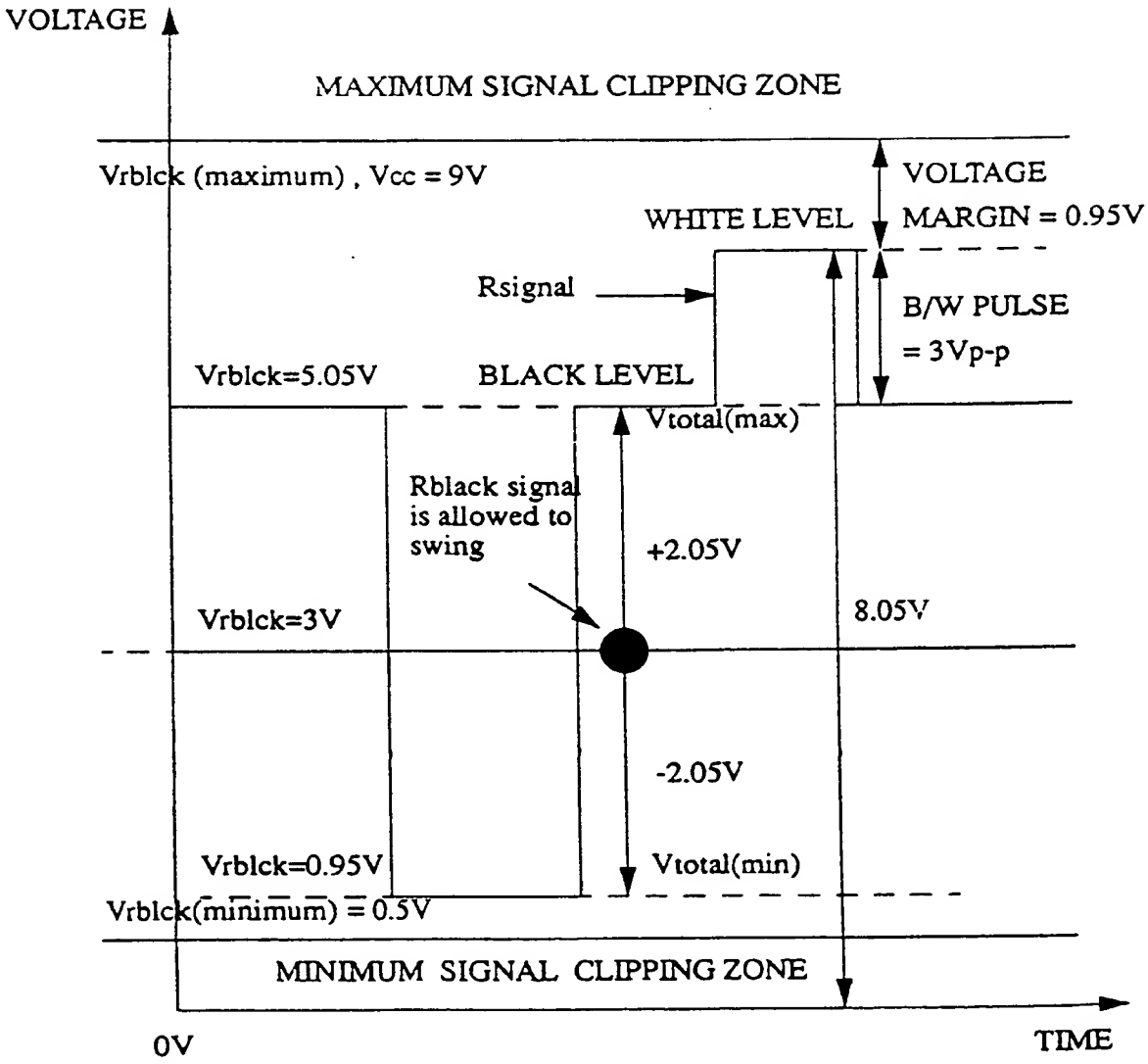
TIME

Figure 2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VOLTAGE
MARGIN = 0.95V
WHITE LEVEL
Rsignal
B/W PULSE
= 3Vp-p
Vrblck=5.05V
BLACK LEVEL
Vtotal(max)
Rblack signal
is allowed to
swing
+2.05V
Vrblck=3V
8.05V
-2.05V
Vrblck=0.95V
Vtotal(min)
Vrblck(minimum) = 0.5V
MINIMUM SIGNAL CLIPPING ZONE
0V
TIME

Figure 3

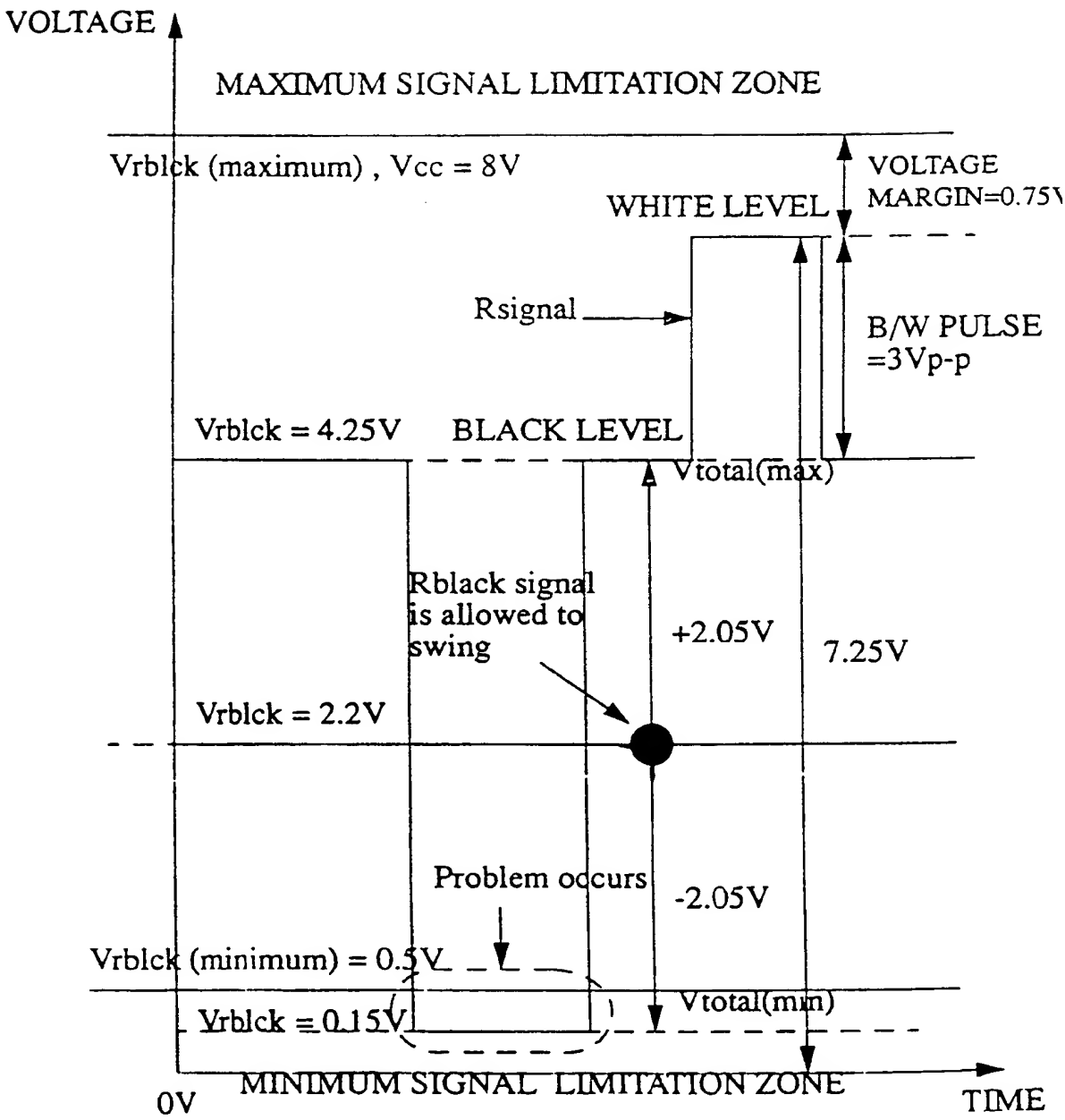
VOLTAGE
MAXIMUM SIGNAL LIMITATION ZONE
Vrblck (maximum) , Vcc = 8V
VOLTAGE MARGIN=0.75V
WHITE LEVEL
Rsignal
B/W PULSE =3Vp-p
Vrblck = 4.25V
BLACK LEVEL
Vtotal(max)
Rblack signal is allowed to swing
+2.05V
7.25V
Vrblck = 2.2V
Problem occurs
-2.05V
Vrblck (minimum) = 0.5V
Vtotal(min)
Vrblck = 0.15V
0V
MINIMUM SIGNAL LIMITATION ZONE
TIME

Figure 4

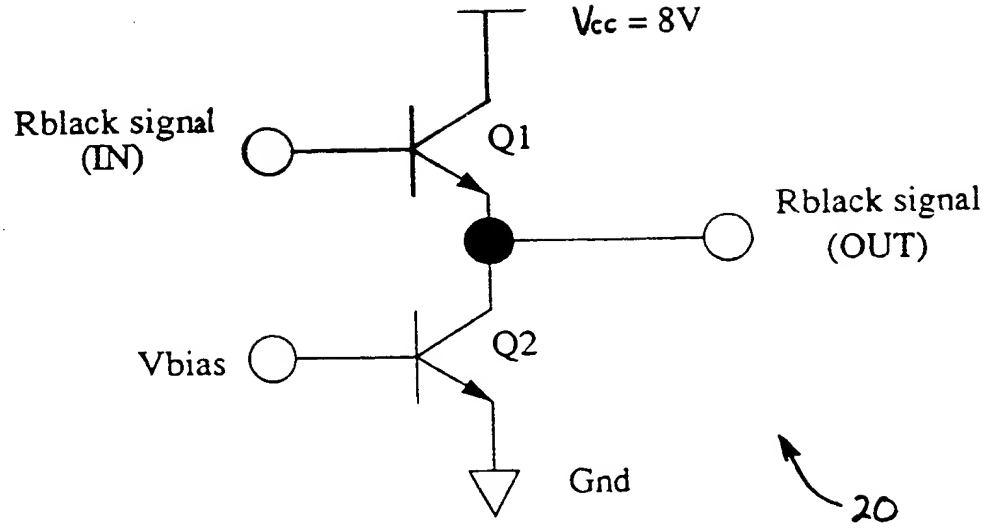

Figure 5

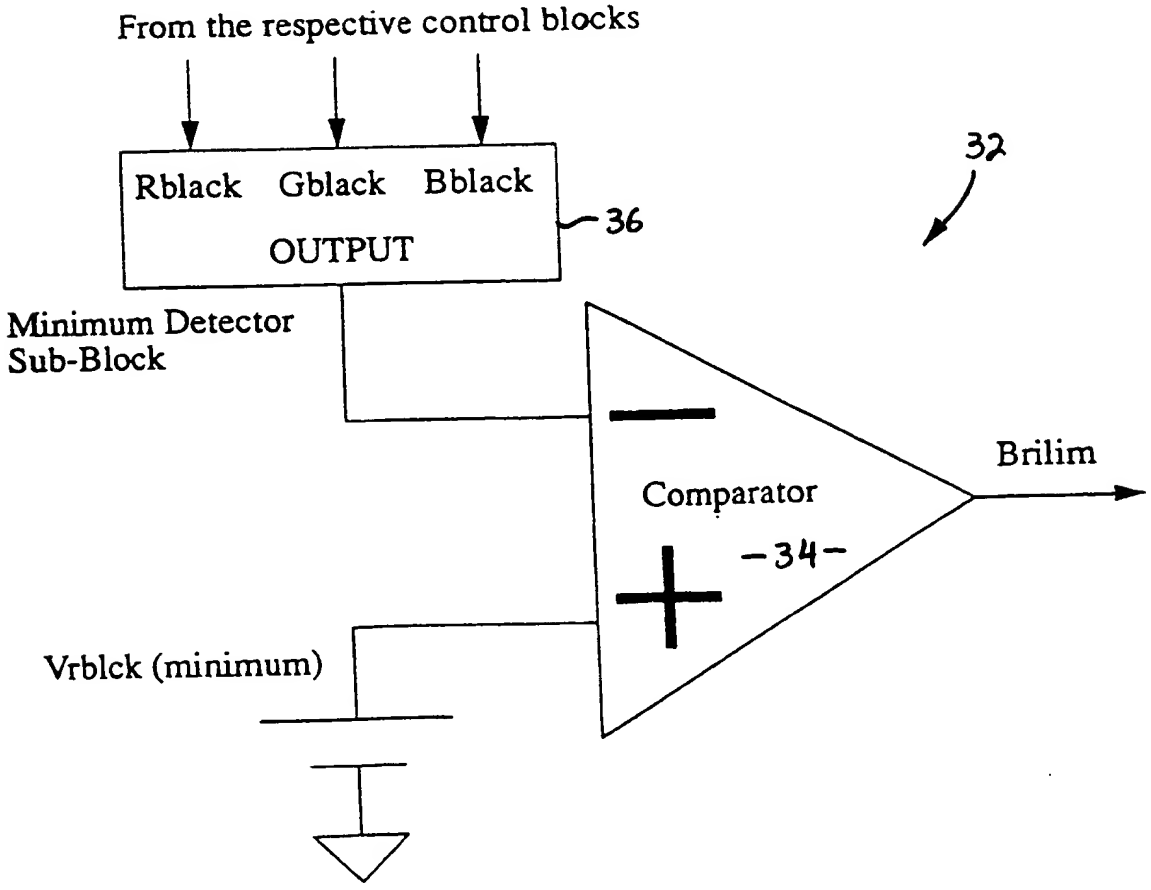

Figure 7

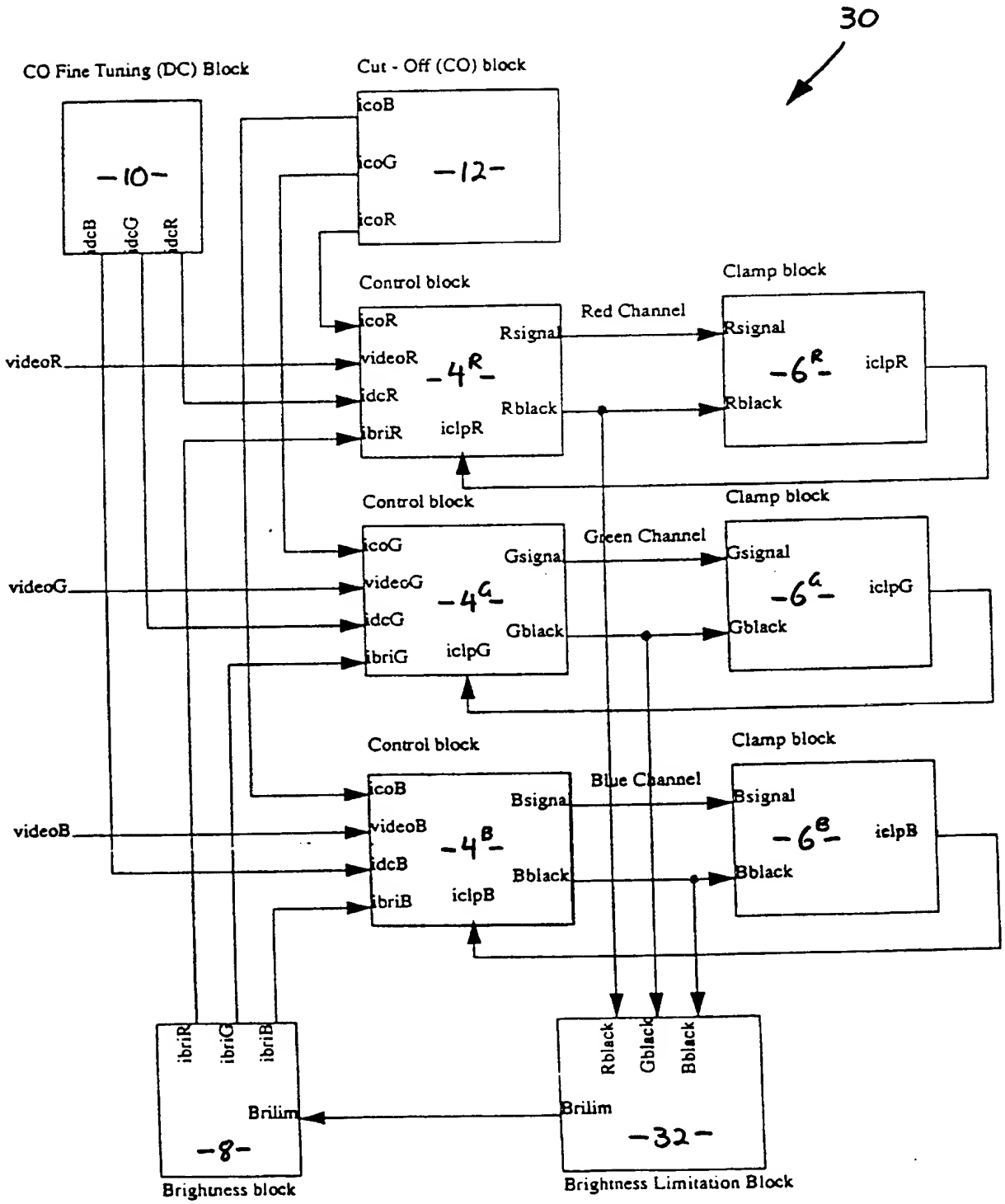
30
CO Fine Tuning (DC) Block
-10-
idcB
idcG
idcR
Cut - Off (CO) block
icoB
icoG
-12-
icoR
Control block
Clamp block
Red Channel
icoR
Rsignal
videoR
videoR
-4R-
-6R-
iclpR
idcR
Rblack
Rblack
ibriR
iclpR
Control block
Clamp block
Green Channel
icoG
Gsigna
Gsignal
videoG
videoG
-4G-
-6G-
iclpG
idcG
Gblack
Gblack
ibriG
iclpG
Control block
Clamp block
Blue Channel
icoB
Bsigna
Bsignal
videoB
videoB
-4B-
-6B-
iclpB
idcB
Bblack
Bblack
ibriB
iclpB
ibriR
ibriG
ibriB
Brilim
-8-
Brightness block
Rblack
Gblack
Bblack
Brilim
-32-
Brightness Limitation Block

Figure 6

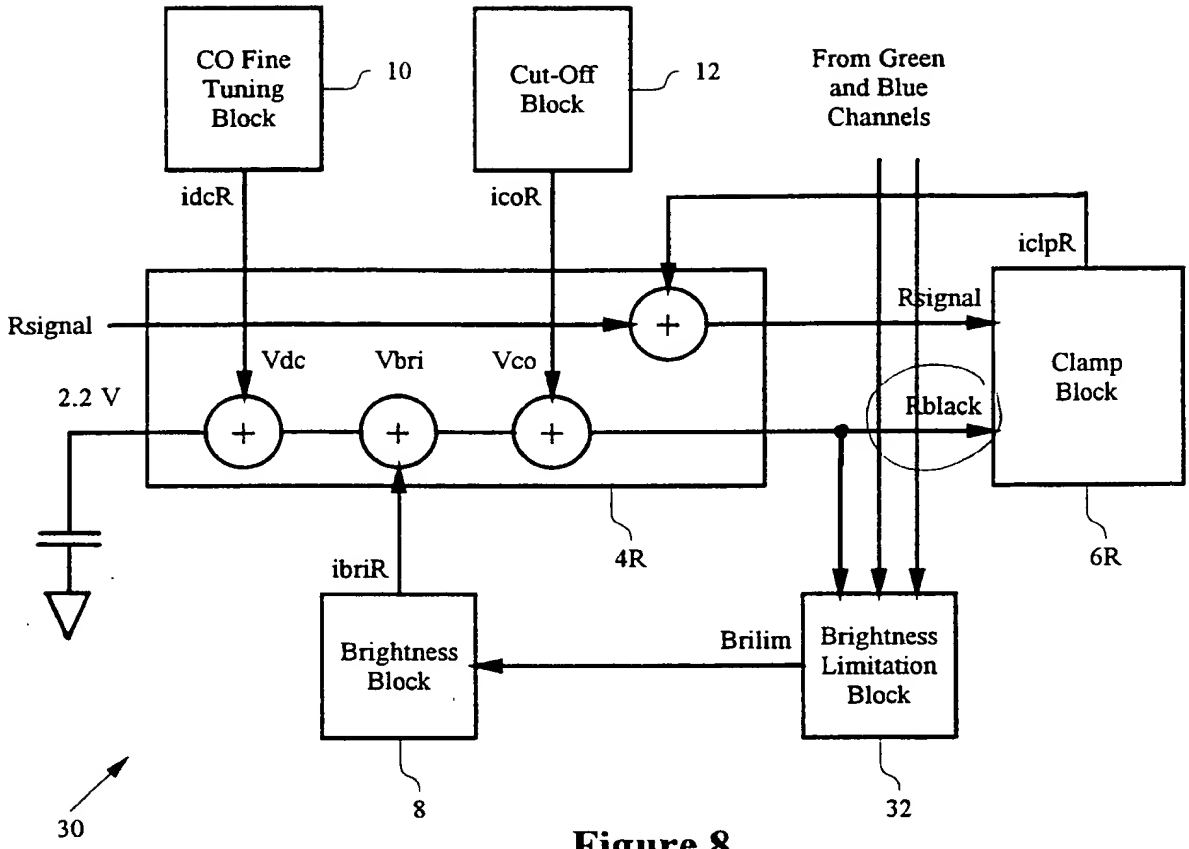
CO Fine Tuning Block
10
Cut-Off Block
12
From Green and Blue Channels
idcR
icoR
iclpR
Rsignal
Rsignal
Vdc
Vbri
Vco
2.2 V
Rblack
Clamp Block
4R
6R
ibriR
Brightness Block
Brilim
Brightness Limitation Block
8
32
30

Figure 8

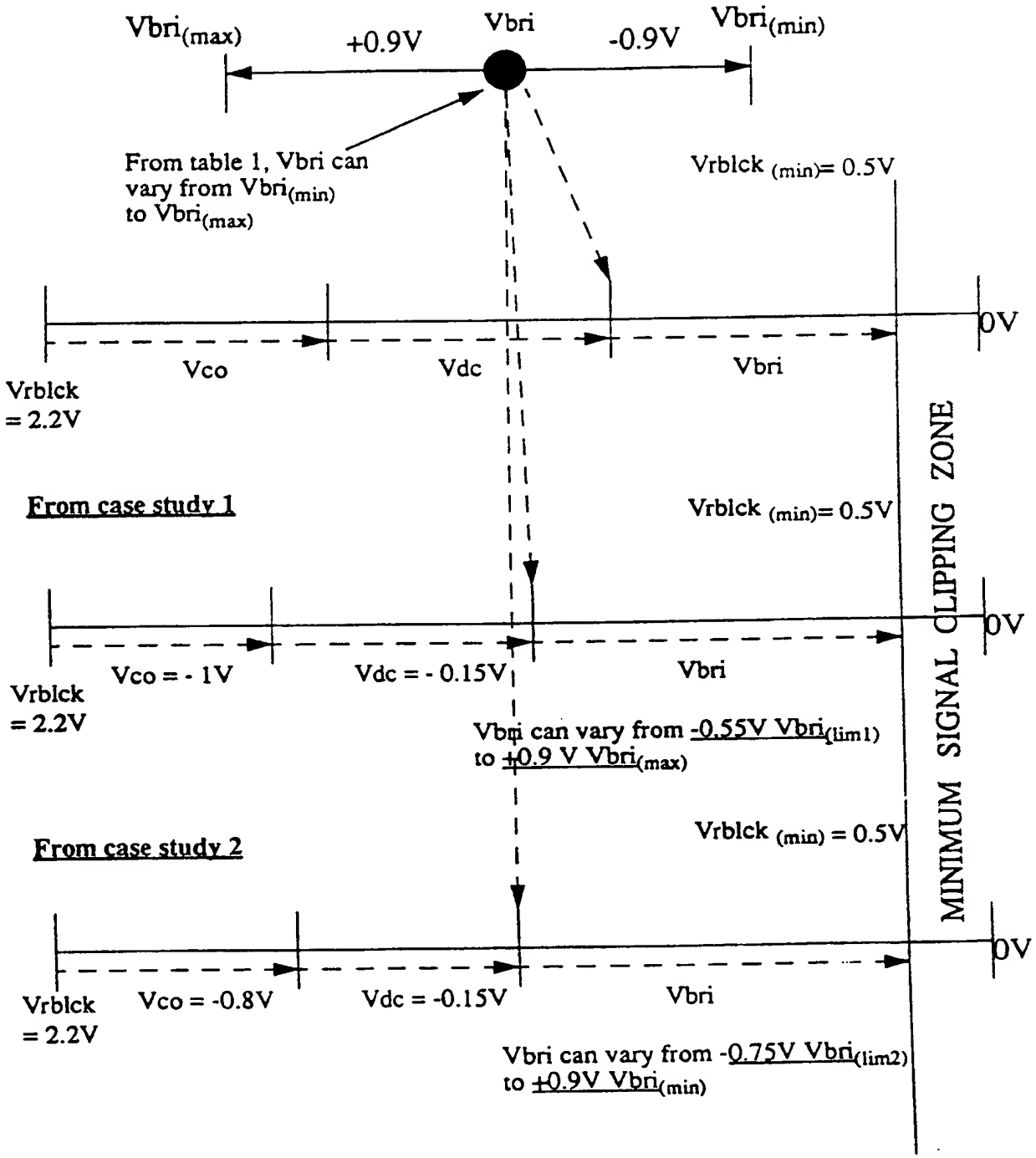
Vbri(max)
+0.9V
Vbri
-0.9V
Vbri(min)
From table 1, Vbri can vary from Vbri(min) to Vbri(max)
Vrblck (min)= 0.5V
0V
Vco
Vdc
Vbri
Vrblck = 2.2V
From case study 1
Vrblck (min)= 0.5V
0V
Vco = - 1V
Vdc = - 0.15V
Vbri
Vrblck = 2.2V
Vbri can vary from -0.55V Vbri(lim1) to +0.9 V Vbri(max)
MINIMUM SIGNAL CLIPPING ZONE
From case study 2
Vrblck (min) = 0.5V
0V
Vrblck = 2.2V
Vco = -0.8V
Vdc = -0.15V
Vbri
Vbri can vary from -0.75V Vbri(lim2) to +0.9V Vbri(min)

Figure 9

INTERNATIONAL SEARCH REPORT

Inter ɔnal Application No
PCT/SG 98/00031

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04N5/59 H04N9/72

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 542 347 A (N.V. PHILIPS' GLOEILAMPENFABRIEKEN) 19 May 1993 see page 3, line 30 - page 5, line 5	1,9,11
A	US 4 642 690 A (RCA CORP) 10 February 1987 see column 3, line 25 - column 4, line 65 see abstract; figure 1	1,9,11
A	EP 0 499 354 A (NATIONAL SEMICONDUCTOR CORPORATION) 19 August 1992 see abstract; figures 3,4	1,9,11
A	PATENT ABSTRACTS OF JAPAN vol. 11, no. 127 (E-501) & JP 61 273075 A (NEC CORP), 3 December 1986 see abstract	1,9,11

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 January 1999	15/01/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Pigniez, T

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte onal Application No
PCT/SG 98/00031

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 542347 A	19-05-1993	DE 69220001 D	03-07-1997
		DE 69220001 T	11-12-1997
		JP 5276528 A	22-10-1993
		US 5278476 A	11-01-1994
US 4642690 A	10-02-1987	DD 237563 A	16-07-1986
		EP 0173539 A	05-03-1986
		JP 61061571 A	29-03-1986
EP 499354 A	19-08-1992	US 5107189 A	21-04-1992
		JP 4320165 A	10-11-1992

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
SGS/59956		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/SG 98/00031	30/04/1998	
Applicant		
SGS-THOMSON MICROELECTRONICS ASIA PAC. .....et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. ☐ **Certain claims were found unsearchable** (see Box I).

2. ☐ **Unity of invention is lacking** (see Box II).

3. ☐ The international application contains disclosure of a **nucleotide and/or amino acid sequence listing** and the international search was carried out on the basis of the sequence listing
   - ☐ filed with the international application.
   - ☐ furnished by the applicant separately from the international application,
     - ☐ but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.
   - ☐ Transcribed by this Authority

4. With regard to the **title,**
   - ☒ the text is approved as submitted by the applicant
   - ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**
   - ☒ the text is approved as submitted by the applicant
   - ☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this International Search Report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is:
   Figure No. 8
   - ☒ as suggested by the applicant.
   - ☐ because the applicant failed to suggest a figure.
   - ☐ because this figure better characterizes the invention.
   - ☐ None of the figures.

PATENT COOPERATION TREATY

PCT

REC'D 19 JUN 2000
WIPO PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
SGS/59956		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/SG98/00031	30/04/1998	30/04/1998
International Patent Classification (IPC) or national classification and IPC H04N5/59		
Applicant SGS-THOMSON MICROELECTRONICS ASIA PAC. .....et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 1 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☒ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
16/11/1999	15.06.2000
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer de Dieuleveult, A Telephone No. +49 89 2399 8946

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/SG98/00031

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-11 as originally filed

Claims, pages:

12,13 as originally filed

14 as amended under Article 19

Drawings, sheets:

1/8-8/8 as originally filed

2. The amendments have resulted in the cancellation of:

☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

☐ restricted the claims.

☐ paid additional fees.

☐ paid additional fees under protest.

☐ neither restricted nor paid additional fees.

2. ☒ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

☐ complied with.

☒ not complied with for the following reasons:

see separate sheet

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

☒ all parts.

☐ the parts relating to claims Nos. .

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-13
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-13
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-13
	No:	Claims	

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

IV. Lack of unity

As is readily seen from the cited documents, the contribution of claims 1, 9 and 13 over the prior art lies in the fact that the feedback signal is provided by "a comparison of the minimum signal level amongst the colour channel reference signals and a fixed reference signal level".
However, this feature is missing in claim 11 (see claim 12) which is therefore not linked with the other independent claims so as to form a single general inventive concept (Rule 13.1 PCT).

V. Reasoned statement

1. Claims 1-10 and 13:
Since the available prior art documents fail to disclose or to fairly suggest the combination of features mentioned above with respect to claims 1, 9 and 13, these claims appear to meet the requirements of Article 33 PCT.
The same conclusion applies to their respective dependent claims.

2. Claims 11 and 12:
The combination of features claimed in independent claim 11 is not rendered obvious either by these prior art documents.
Together with its dependent claim 12, claim 11 thus appears to satisfy the conditions of Article 33 PCT.

VII. Certain defects

1. A document reflecting the prior art described on page 4, line 3 to page 8, line 12, is not identified in the description (Rule 5.1(a)(ii) PCT).

2. The independent claims are not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art being placed in the preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).

3. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

a plurality of clamping means, each clamping means corresponding to a respective colour channel control means and being coupled to receive as input the respective adjusted colour channel video signal and adjusted colour channel reference signal and produce a corresponding clamping feedback signal; and

a brightness limitation means coupled to receive the adjusted colour channel reference signal from each colour channel control means and produce a corresponding brightness feedback signal;

wherein each said colour channel control means includes a first adder in path of the colour channel video signal, to which said clamping feedback signal is coupled, and a second adder in the path of the colour channel reference signal, to which said brightness feedback signal is coupled.

12. A video signal brightness controller as claimed in claim 11, wherein said brightness limitation means comprises a minimum signal level detector for detecting a minimum signal level amongst the plurality of adjusted colour channel reference signals, and a comparator for generating said brightness feedback signal on the basis of the detected minimum signal level and a fixed reference signal level.

13. A method for regulating colour channel video information signals, comprising the steps of detecting a minimum signal level amongst a plurality of colour channel reference signals, comparing said minimum signal level with a fixed voltage reference signal and generating a corresponding comparator output, and providing an additive feedback coupling of said comparator output signal and each of said colour channel reference signals.

a plurality of clamping means, each clamping means corresponding to a respective colour channel control means and being coupled to receive as input the respective adjusted colour channel video signal and adjusted colour channel reference signal and produce a corresponding clamping feedback signal; and

a brightness limitation means coupled to receive the adjusted colour channel reference signal from each colour channel control means and produce a corresponding brightness feedback signal;

wherein each said colour channel control means includes a first adder in path of the colour channel video signal, to which said clamping feedback signal is coupled, and a second adder in the path of the colour channel reference signal, to which said brightness feedback signal is coupled.

12. A video signal brightness controller as claimed in claim 11, wherein said brightness limitation means comprises a minimum signal level detector for detecting a minimum signal level amongst the plurality of adjusted colour channel reference signals, and a comparator for generating said brightness feedback signal on the basis of the detected minimum signal level and a fixed reference signal level.

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3 March 1999

BY FAX & POST

COPY

International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20
SWITZERLAND

Dear Sirs

PCT Patent Application No. PCT/SG98/00031
- International Phase
AUTOMATIC BRIGHTNESS LIMITATION FOR AVOIDING VIDEO SIGNAL CLIPPING
SGS-THOMSON Microelectronics Asia Pacific (Pte) Ltd

In response to the International Search Report in connection with the above identified application, we enclose herewith amended page 14 (in triplicate) and ask that it be substituted for page 14 of the specification at present on file pursuant to Article 19 of the PCT. The amended page 14 includes a new claim 13, which is a method claim based on original claim 9.

Yours faithfully

Encls.

a plurality of clamping means, each clamping means corresponding to a respective colour channel control means and being coupled to receive as input the respective adjusted colour channel video signal and adjusted colour channel reference signal and produce a corresponding clamping feedback signal; and

a brightness limitation means coupled to receive the adjusted colour channel reference signal from each colour channel control means and produce a corresponding brightness feedback signal;

wherein each said colour channel control means includes a first adder in path of the colour channel video signal, to which said clamping feedback signal is coupled, and a second adder in the path of the colour channel reference signal, to which said brightness feedback signal is coupled.

12. A video signal brightness controller as claimed in claim 11, wherein said brightness limitation means comprises a minimum signal level detector for detecting a minimum signal level amongst the plurality of adjusted colour channel reference signals, and a comparator for generating said brightness feedback signal on the basis of the detected minimum signal level and a fixed reference signal level.

13. A method for regulating colour channel video information signals, comprising the steps of detecting a minimum signal level amongst a plurality of colour channel reference signals, comparing said minimum signal level with a fixed voltage reference signal and generating a corresponding comparator output, and providing an additive feedback coupling of said comparator output signal and each of said colour channel reference signals.

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 15 December 1999 (15.12.99)	
International application No. PCT/SG98/00031	**Applicant's or agent's file reference** SGS/59956
International filing date (day/month/year) 30 April 1998 (30.04.98)	**Priority date** (day/month/year)
Applicant YEE, Chee, Weng et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

16 November 1999 (16.11.99)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

S. Mafla

Telephone No.: (41-22) 338.83.38